Appendix 3

Holmes and Holmes Pty Ltd

Acid Sulphate Soil Investigation
March 2003

RECORD OF BOREHOLE No. 107

CLIENT: Luke & Company

PROJECT: A.S.S Assessment, Lake Cathie

Ground level: ..... Dia. of boring: 80 mm

Aimil Pty. Ltd, MD200, Toyota - mounted

Type of boring: continuous solid flight auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A U D Level	Description of Strata	A.S.S Potential
21.3.03						CLAY mod. plasticity Brown moist/wet soft	
				1.0		SANDY CLAY mod. plasticity Br. & yell. wet, soft	
						FINE SAND, slightly silty Yellow wet, loose	
	Sample 107/1	D		2.0			
						FINE SAND Grey saturated, loose	Very slight potential No management required
				3.0			
	Sample 107/2	D				Esturine CLAY Grey with yellow streaks wet, soft	Very high Potential
				4.0			
	Sample 107/3	D				Slightly SANDY CLAY Grey wet, soft	High Potential Requires management
				5.0			
				6.0		End of Hole	

Key to type of sample

U (50) – 50 mm. dia. undisturbed sample.

D – disturbed sample.

N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm penetration

Remarks: (Observations on ground-water, etc.)

RECORD OF BOREHOLE No. 108

CLIENT: Luke & Company

PROJECT: A.S.S Assessment, Lake Cathie

Ground level: ..... Dia. of boring: 80 mm

Auger Pty. Ltd, MD200, Toyota - mounted

Type of boring: continuous solid flight auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: R.L. or Level	Description of Strata	A.S.S Potential
21.3.03				1.0		CLAY high plasticity Grey moist soft / firm	
						CLAYEY SAND mod. plasticity light grey, wet, soft	
				2.0		FINE SAND Light grey Saturated loose	Very slight potential No management required
	Sample 108/1	D		3.0		FINE SAND, Slightly silty Grey, saturated loose	
	Sample 108/2	D		4.0		Esturine CLAY Grey wet soft	Very high potential Requires management
	Sample 108/3	D		5.0		Slightly SANDY CLAY Grey wet, soft	High potential
				6.0		End of Hole	

Key to type of sample

U (50) – 50 mm. dia. undisturbed sample.

D – disturbed sample.

N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm penetration

Remarks: (Observations on ground-water, etc.)

RECORD OF BOREHOLE No. 109

CLIENT: Luke & Company
PROJECT: A.S.S Assessment, Lake Cathie

Ground level: ..... Dia of boring: 80 mm
Aimil Pty Ltd MD20D Toyota-mounted
Type of boring: continuous solid flight auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: R.L. or D	Description of Strata	A.S.S Potential
21.3.03						Sandy Topsoil	
				1.0		FINE SAND Brown wet, loose	
	Sample 109/1	D		2.0		FINE SILTY SAND Brown saturated medium dense	High Potential requires management
	Sample 109/2	D		3.0		CLAYEY SAND fine grained Grey saturated loose/med. dense	very slight potential c/o management required.
	Sample 109/3	D		4.0		Esturine CLAY Dark grey v. wet, v. soft	Very high Potential requires management
				5.0			
				6.0			

Key to type of sample
U (50) – 50 mm. dia. undisturbed sample.
D – disturbed sample
N ( ) – standard penetration test.
No. in brackets gives
No. of blows/300 mm. penetration

Remarks (Observations on ground water, etc.)

RECORD OF BOREHOLE No. 110

CLIENT: Luke & Company

PROJECT: A.S.S Assessment, Lake Cathie

Ground level: ..... Dia. of boring: 80 mm.

Aimil Pty. Ltd, MD200, Toyota-mounted

Type of boring continuous solid flight auger Casing tubes nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: R.L. or D level	Description of Strata	A.S.S Potential
21.3.03				1.0		CLAY high plasticity Grey with some yellow mottling moist/wet soft	
	Sample 110/1			2.0		FINE SAND white wet, loose	Very slight potential no management required
	Sample 110/2			3.0		FINE SAND, slightly silty dirty white saturated med. dense	Slight Potential
	Sample 110/3			4.0		Serpentinite CLAY high plasticity greenish grey soft, wet	Moderate Potential Requires management
				5.0		V bit refusal in Serpentinite	
				6.0			

Key to type of sample

U 150 – 50 mm. dia. undisturbed sample.

D – disturbed sample.

N (4) – standard penetration test.

No in brackets gives No. of blows/300 mm. penetration

Remarks: (Observations on ground-water, etc.)

RECORD OF BOREHOLE No. 111

CLIENT: Luke & Company

PROJECT: A.S.S Assessment, Lake Cathie

Ground level: ..... Dia. of boring: 80 mm

Type of boring: Aimil Pty. Ltd, MD200, Toyota-mounted continuous solid flight auger Lining tubes: nil

Date / Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A H D Level	Description of Strata	A.S.S Potential
21.3.03						Clayey Topsoil	
						CLAY high plasticity Brown moist, firm/soft	
				1.0		CLAYEY SAND, Grey wet, soft	
						FINE SAND Yellow wet, loose	
				2.0			
	Sample 111/1	D				SILTY SAND fine grained wet, med. dense/loose	Slight potential requires management
				3.0			
						SANDY CLAY Red brown wet. soft	
						CLAY, high plasticity Yellow brown moist, firm	
				4.0		End of Hole in residual clays	
				5.0			
				6.0			

Key to type of sample
- U (50) – 50 mm. dia. undisturbed sample
- D – disturbed sample
- N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm penetration

Remarks (Observations on ground-water, etc.)

RESULTS OF ACID SULPHATE SOIL ANALYSIS (Page 1 of 1)

13 samples supplied by Holmes & Holmes on 26th March, 2003 - Lab. Job No. E0244
Analysis requested by Bill Holmes - Your Project: Order No. M0095

Sample Site	Depth (m)	Texture (note 9)	Reduced Inorganic Sulphur (% chromium reducible S) (%Scr), (note 2)	% ANC %CaSO$_4$ (note 11)	NAGP Kg H_2SO_4/ Tonne soil (note 12)	TAA pH	Total Actual Acidity (TAA) mole / Kg	Lab. Bulk Density tonne DW/m^3	Potential Acidity Neutralising Calculation Kg Lime/m^3 (based on %Scr)	Potential Acidity Neutralising Calculation Kg Lime/m^3 (based on NAGP)	Actual Acidity Neutralising Calculation Kg Lime/m^3 (based on TAA)	COMMENTS RE: Classification as potential acid sulphate soil (based on %Scr results)
107/1	2.3-2.8	Coarse	0.033	0.05	0.5	4.68	0.004	1.70	1.8	0.9	0.3	NOT Potential ASS
107/2	3.8-4.4	Fine	0.978	0.00	30.6	4.99	0.006	1.17	35.1	35.9	0.3	YES Potential ASS
107/3	5.2-5.8	Fine	0.212	0.00	5.6	5.47	0.001	1.39	9.0	9.3	0.0	YES Potential ASS
108/1	2.3-2.8	Coarse	0.018	..	..	5.10	0.002	1.77	1.0	..	0.1	NOT Potential ASS
108/2	3.8-4.4	Fine	0.858	0.35	23.4	4.95	0.005	1.44	37.9	33.7	0.3	YES Potential ASS
108/3	5.0-5.5	Fine	0.305	0.40	5.5	5.46	0.001	1.40	13.1	7.8	0.0	YES Potential ASS
109/1	2.3-2.8	Coarse	0.217	0.00	6.8	5.02	0.006	1.57	10.4	10.6	0.5	YES Potential ASS
109/2	3.5-4.0	Coarse	0.009	..	..	4.83	0.007	1.46	0.4	..	0.5	NOT Potential ASS
109/3	5.0-5.5	Fine	0.948	0.00	29.7	4.90	0.008	1.03	30.6	30.6	0.4	YES Potential ASS
110/1	2.0-2.4	Coarse	0.008	..	..	5.78	0.000	1.52	0.4	.	0.0	NOT Potential ASS
110/2	2.8-3.2	Coarse	0.051	0.15	0.1	6.05	0.000	1.38	2.1	0.1	0.0	YES Potential ASS
110/3	3.5-4.0	Fine	0.206	0.45	1.9	6.99	0.000	1.43	9.0	2.8	0.0	YES Potential ASS
111/1	2.3-2.8	Coarse	0.106	0.10	2.3	4.73	0.008	1.51	4.9 Refer Note 6 & 7	3.5 Refer Note 6 & 7	0.6 Refer Note 6 & 7	YES Potential ASS

NOTE:

1 - All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2 - Samples analysed by POCAS method (ie Peroxide Oxidation - Combined Acidity and Sulphate - Version 3 modified published method) and 'Chromium Reducible Sulphur' technique (Scr - Method 22B)

3 - Methods from Stone, Y, Ahern CR, and Blunden B (1998). Acid Sulphate Soil Manual 1998. ASSMAC Wollongbar, NSW.

4 - Total carbon and total sulphur determined using a LECO CNS 2000 analyser

5 - Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)

6 - Neutralising Requirement (based on NAGP, chromium reducible sulphur or total sulphur) = Kg H_2SO_4/tonne x bulk density

7 - The neutralising requirement does not include a safety margin for complete neutralisation (a factor of 1.5 is often recommended)

8 - Conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm

9 - For Texture: coarse = sands to loamy sands; medium = sandy loams to light clays; fine = medium to heavy clays and silty clays.

10 - Neutralisation Calculation for neutralisation of actual and potential acidity (ie. sum of calculation based on Scr and TAA)

11 - ANC= Acid Neutralising Capacity of the Soil (Detection limit of 0.05% $CaCO_3$ Equivalent)

12 - NAGP= Net Acid Generating Potential= (31.2*%S_{Cr})-(10*%ANC) (From Mulvey, 1993)

(Classification of potential acid sulphate material if: coarse Scr≥0.03%S; medium Scr≥0.06%S fine Scr≥0.1%S)

(equivalent conversions - 0.03%S = 0.019 mole/ Kg; 0.06%S = 0.037 mole/ Kg; 0.1%S = 0.062 mole/ Kg)

* Projects that disturb >1000 tonnes of ASS soils with ≥0.03% S a detailed management plan may be required

checked: .....